

SSME FMEA/CIL
REDUNDANCY SCREEN

Component Group: Propellant Valves
 CIL Item: O600-04
 Component: Recirculation Isolation Valve
 Part Number: RS010161
 Failure Mode: Erroneous position feedback signal.

Prepared: P. Lowrmore
 Approved: T. Nguyen
 Approval Date: 8/30/99
 Change #: 1
 Directive #: CCBD ME3-01-5228
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| Phase | Failure / Effect Description | Criticality Hazard Reference |
|----------|--|---------------------------------|
| P 4 2 | Erroneous signal not detected by controller results in loss of protection against failure of valve to open. Loss of vehicle due to helium ingestion during cutoff may result if RIV fails to open and is not detected. Redundancy Screens: SENSOR SYSTEM - VALVE SYSTEM: UNLIKE REDUNDANCY A: Pass - Redundant hardware items are capable of checkout during normal ground turnaround. B: Fail - Loss of a redundant hardware items is not detectable during flight. C: Pass - Loss of redundant hardware items could not result from a single credible event. | IR ME C1A,C |

SSME FAULT
DESIGN

Component Group: Propellant Valves
CIL Item: D600-04
Component: Recirculation Isolation Valve
Part Number: RS010161
Failure Mode: Erroneous position feedback signal.

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Design / Document Reference

FAILURE CAUSE: A: Damaged armature.

THE ARMATURE (1) IS MANUFACTURED FROM HY-MU 80 ALLOY BAR (2) COLD DRAWN AND MAGNETIC ANNEALED. MATERIAL IS SELECTED FOR ITS MAGNETIC PERMABILITY AND COERCIVE FORCE. THE HOUSING (3) PROTECTS THE ARMATURE FROM THE OUTSIDE ELEMENTS. THE MINIMUM DIAMETRICAL CLEARANCE BETWEEN ARMATURE O.D. AND THE TRANSFORMER HOUSING BORE IS CONTROLLED (4). THE ARMATURE IS DRY-FILM LUBRICATED (5). THE ARMATURE EXTENSION (1) IS HEAT TREATED INCONEL 718. THE MATERIAL WAS SELECTED FOR ITS STRENGTH, DUCTILITY, AND WELDABILITY (6). THE EXTENSION IS KNURLED FOR A TIGHT FIT ON THE ARMATURE I.D. THE ARMATURE IS RETAINED BY AN E.B. WELDED GUIDE ON THE END OF THE EXTENSION (7).

(1) 55-494; (2) MIL-N-14411, COMP 1; (3) 40-124; (4) GM5616-2, RES1253; (5) RB0140-017, TYPE I; (6) RSS-8582

FAILURE GAUSE: B: Open or short circuit.

C: Change of internal resistance caused by moisture, corrosion, or contamination.

PARTS FOR THE CIRCUITS INVOLVED IN THIS FUNCTION HAVE BEEN SELECTED FROM THE MSFC CLASS S OR EQUIVALENT APPROVED PARTS SELECTION (1). ELECTRICAL CONNECTOR IS DESIGNED TO SEAL AGAINST MOISTURE/CONTAMINATION (2). RECEPTACLE PINS ARE NICKEL UNDERPLATED AND GOLD OVERPLATED TO PREVENT CORROSION (3). GLASS BEADS (4) FILL ALL CAVITIES AND PREVENT WIRE MOVEMENT. THE CAVITY IS EVACUATED AND BACK-FILLED WITH HELIUM. A TEFLON PLUG IS INSERTED IN THE ACCESS PASSAGEWAY AND A BALL IS RESISTANCE WELDED TO THE HOUSING ACCESS PORT. THE BALL RECESS IS POTTED (5) FLUSH WITH TOP OF FLANGE. THIS DESIGN PREVENTS MOISTURE/CONTAMINATION PROBLEMS (6). SOLDERING OF ELECTRICAL CONNECTIONS AND TERMINAL CONNECTIONS ARE CONTROLLED BY SPECIFICATION (7). PRIMARY AND SECONDARY COILS ARE DESIGNED SO THEY ARE INSULATED FROM EACH OTHER (8). THE FUEL AND OXIDIZER BLEED VALVES WITH THE POSITIONING INDICATOR ATTACHED HAS SUCCESSFULLY PASSED DESIGN VERIFICATION TESTING (9), WHICH INCLUDED PRESSURE CYCLING (10), AND VIBRATION TESTING (11).

(1) 85M03928; (2) RES1232; (3) MSFC-SPEC-522; (4) MIL-G-0054, SIZE 12; (5) MSFC-SPEC-222; (6) RES1253; (7) MSFC-SPEC-278; (8) GM6516; (9) DVS-SSME-616; (10) RSS-516-17; (11) RSS-516-20

**SSME FMEA/CIL
INSPECTION AND TEST**

Component Group: Propellant Valves
 CIL Item: D600-04
 Component: Recirculation Isolation Valve
 Part Number: RS010161
 Failure Mode: Erroneous position feedback signal.

Prepared: P. Lowrmore
 Approved: T. Nguyen
 Approval Date: 6/30/99
 Change #: 1
 Directive #: CCBD ME3-01-5225
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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|---|---|-----------------------|
| A | POSITION INDICATOR | | RES1253 |
| | MATERIAL INTEGRITY | MATERIAL INTEGRITY IS VERIFIED PER DRAWING REQUIREMENTS. | |
| | | ARMATURE DRY-FILM LUBRICATION IS INSPECTED PER SPECIFICATION AND DRAWING REQUIREMENTS. | RB0140-017 RES1253 |
| | | DIAMETRICAL CLEARANCE BETWEEN ARMATURE AND TRANSFORMER BORE IS INSPECTED PER DRAWING REQUIREMENTS. | RES1253 |
| B, C | POSITION INDICATOR | | RES1253 |
| | PLATING INTEGRITY | THE PLATING IS VERIFIED PER DRAWING REQUIREMENTS. | |
| | SOLDERING INTEGRITY | ELECTRICAL SOLDERING IS INSPECTED PER SPECIFICATION REQUIREMENTS. | |
| | ASSEMBLY CLEANLINESS | CLEANLINESS IS VERIFIED DURING ASSEMBLY AND TESTING PER SPECIFICATION REQUIREMENTS. | RL10001 RES1253 |
| | ASSEMBLY INTEGRITY | EACH TRANSDUCER IS EXAMINED FOR QUALITY OF WORKMANSHIP PER SPECIFICATION REQUIREMENTS | RES1253 |
| | | THE FOLLOWING TESTS ARE PERFORMED DURING MANUFACTURING AND ACCEPTANCE TESTING: - INSULATION RESISTANCE BETWEEN COILS AND CASE. - DIELECTRIC WITHSTANDING VOLTAGE TEST TO VERIFY CURRENT LEAKAGE IS WITHIN SPECIFICATION REQUIREMENTS. - STROKE DEFLECTION TESTS TO VERIFY PROPER DISPLACEMENT, OUTPUT VOLTAGE, AND PHASING. - SCALE FACTOR AND LINEARITY TEST. - LOW TEMPERATURE FUNCTIONAL TEST. - HELIUM BACK FILL AND LEAK TEST. | |
| ALL CAUSES | WELD INTEGRITY | ALL WELDS ARE INSPECTED TO DRAWING AND SPECIFICATION REQUIREMENTS. | RL10011 RA0607-094 |
| | HOT-FIRE ACCEPTANCE TESTING (GREEN RUN) | VALVE OPERATION IS VERIFIED THROUGH HOT-FIRE ACCEPTANCE TESTING. | RL00461 |

D - 199

Component: 2491 210penant valves
 CII Item: D600-04
 Component: Recirculation Isolation Valve
 Part Number: RS010181
 Failure Mode: Erroneous position feedback signal.

Prepared: P. Lowrie
 Approved: T. Nguye
 Approval Date: 6/30/99
 Change #: 1
 Directive #: GCBD MEJ-01-6228
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| Failure Causes | Significant Characteristics | Inspection(s) / Test(s) | Document Reference |
|----------------|-----------------------------|--|--|
| ALL CAUSES | PRE-FLIGHT CHECKOUT | POSITION INDICATOR OPERATION IS VERIFIED DURING EACH FLIGHT FLOW BY THE FOLLOWING TESTS: - FLIGHT READINESS TEST. - CONTROLLER POWER UP. - SENSOR CHECKOUT. - PURGE SEQUENCE 3 (RIV CLOSED LAST TEST). - PNEUMATIC CHECKOUT MODULE. - PRE-CRYO LOADING CONFIGURATION VERIFICATION. - ACCEPTANCE OF START ENABLE COMMAND (RIV OPEN LAST TEST). | OMRSD S00FA0.211 OMRSD S00FA0.213 OMRSD S00FA0.213 OMRSD S00E00.150 OMRSD S00FA0.213 OMRSD S00FA0.213 CP406R0002 |

D - 200

Failure History: Comprehensive failure history data is maintained in the Problem Reporting database (PRAMS/PRACA)
 Reference: NASA letter SA21/88/308 and Rockaldyne letter 88RC09751.
 Operational Use: Not Applicable.

SSME / RA/CIL
WELD JINTS

Component Group: Propellant Valves
 CIL Item: 0600
 Component: Recirculation Isolation Valve
 Part Number: RS010161

Prepared: P. Lowmore
 Approved: T. Nguyen
 Approval Date: 8/30/99
 Change #: 1
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| Component | Basic Part Number | Weld Number | Weld Type | Class | Root Side No Access | Critical Initial Flaw Size Not Detectable | | Comments |
|-----------|-------------------|-------------|-----------|-------|---------------------------|---|-----|----------|
| | | | | | | HCF | LCF | |
| BELLOWS | RS010163 | 1,2 | GTAW | II | X | | | |
| BELLOWS | RS010163 | 5 | GTAW | II | X | | | |
| BELLOWS | RS010163 | 6 | EBW | II | X | | | |
| POPPET | RS010166 | 1 PLACE | EBW | II | X | | | |
| BELLOWS | RS010171 | 1 PLACE | EBW | II | X | | | |